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COMMONWEALTH PHYTOPATHOLOGICAL NEWS

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PLANT PATHOGENIC BACTERIA AND THEIR PHAGES

by J. E. Crosse
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Earlier articles in this series have drawn attention to some of the problems encountered in distinguishing species of plant pathogenic bacteria by biochemical and pathological tests. Even when tests of this nature provide for satisfactory differentiation of species, the procedure involved is often lengthy and time consuming. In recent years there has been a growing interest in the possibility of using bacteriophages for this purpose.

A bacteriophage will cause lysis of a sensitive bacterium if the two are brought into contact. This can be demonstrated by adding a phage preparation to a broth culture of the bacterium, when, after a period, there will be a sudden decrease in the turbidity of the culture. The effect is often temporary and may be followed by an increase in turbidity due to the growth of phage-resistant strains of the bacterium. Lysis can be more satisfactorily demonstrated on an agar plate sown to give a continuous 'lawn' of bacterial growth. If the phage preparation is streaked on the surface of the plate clear zones develop, which may, if the phage preparation is sufficiently dilute, take the form of small, discrete circular areas or 'plaques', where isolated phage particles have been deposited.

Lysis can usually be detected within 24 hours and tends to be highly specific i. e. confined to one bacterial species or to a few closely related species. Hence if a phage specific to a particular bacterium is available it can be utilized for the rapid identification of that bacterium.

Techniques

Contrary to the experience of earlier workers, who tended to use lysis in broth culture to detect the presence of phages, the isolation of phages does not present any major difficulties. Techniques adopted in recent years are all basically the same. The prospective phage source, e. g. plant material or soil from beneath infected host plants, is added to a broth culture of the appropriate bacterium, and after a suitable interval to allow for multiplication of the phage, the broth is centrifuged and the residual bacteria then removed by filtration, or killed by treating the broth with an antibacterial agent, such as chloroform. Phages present in the broth can then be detected by plating it on an agar medium sown with the original host bacterium. Plaques thus formed are 'picked off' and transferred to broth cultures of the bacterium to build up high concentrations of the phage. Phage preparations are purified by methods similar to those used for obtaining pure cultures of bacteria, i. e. by repeated selection from discrete plaques formed on solid media. They are stored in the form of bacteria-free broth suspensions and under suitable conditions may remain stable for long periods.

Phages active against plant pathogenic bacteria have been obtained mainly from soils and plant material. Another possible source, so far little explored, are the so-called 'lysogenic' bacteria. These are 'carrier' strains containing phage material which is propagated with the genetic material of the bacterium and hence is present in all progeny. A lysogenic bacterium is normally tolerant to the phage it carries, but the phage becomes active in a minute fraction of the cells, which are then lysed; phages are liberated into the medium where they can be detected in the presence of a sensitive strain of the bacterium.

Typing the phages

Once a collection of phages has been obtained the next step is to differentiate them. This is normally done by a 'cross-resistance' test, the principle of this being briefly as follows. A culture of a sensitive bacterium is infected with a heavy concentration of phage. Under suitable conditions the whole culture will be lysed except for a few cells which can be selected out to give a strain of the bacterium resistant to that particular phage. This procedure is repeated with other phages and a series of resistant strains thus obtained. The phages are now reciprocally tested against these resistant strains and if one lyses a strain resistant to another, then these two phages are different. Phages can sometimes be distinguished according to the size and morphology of the plaques formed on solid medium. For example, they may form large or small plaques, or plaques with halos or plaques without, and so on.

Specificity

Experience so far with phages of plant pathogenic bacteria indicates that their specificity may vary. Some, for example, may act on more than one species of bacterium (polyvirulent phages) while others may be strain specific, i.e. they may not be active against all strains of the same bacterium.

Something of the possible complexity of phage reactions is illustrated below by some preliminary tests we have recently carried out with Pseudomonas phages:-

Bacterial species and strain no.	Phage isolate			
	1	2	3	4
Ps. mors-prunorum (1)	+	+	+	-
Ps. mors-prunorum (2)	+	+	-	-
Ps. syringae (1)	+	+	+	-
Ps. syringae (2)	-	-	-	-
Ps. phaseolicola (1)	-	∓	∓	+
Ps. phaseolicola (2)		∓	∓	+

\+ active - inactive ∓ weakly active

Notice that while phage 4 was specific for Ps. phaseolicola, phages 1 and 2 were polyvirulent, attacking both strains of Ps. mors-prunorum and one strain of Ps. syringae; phage 2 was also weakly active against Ps. phaseolicola. Phage 3 was strain specific for both Ps. mors-prunorum and Ps. syringae but was weakly active against both Ps. phaseolicola strains. One of the Ps. syringae strains was not affected by any of the phages.

The complex nature of this activity suggests that if a system of phage typing for the plant pathogenic bacteria is to be developed, it will require a thorough study of phage-bacterium relationships, including the testing of as many phages as possible against a wide range of bacterial species and strains. One of the problems may be the isolation of phages of the right degree of specificity, i.e. those capable of differentiating two species of bacteria without at the same time being markedly strain-specific. Polyvirulence may prove less disadvantageous than strain specificity for it may be possible to identify a given bacterial species using more than one polyvirulent phage. For example, if phage I is restricted to species A and B, and phage II to species B and C, then A can be distinguished by testing simultaneously

with both phages.

Taxonomic Problems

It is perhaps worth pointing out that any general study of phage relationships amongst the plant pathogenic bacteria is likely to be complicated by confusion that exists on the taxonomy and natural affinities of these organisms; an important corollary to this is that phage typing may throw some more light on this difficult problem.

Whatever final conclusions are reached on this, there is no doubt that phages have an important part to play in the study of bacterial diseases of plants. The possession of phages for Erwinia amylovora helped considerably in the identification of fire-blight outbreaks in Great Britain during 1958. They are likely to prove equally valuable during 1959, when one of the main problems may be to distinguish quickly between the early stages of fire-blight and bacterial blossom wilt caused by Ps. syringae.

Finally it should not be forgotten that phage typing can also be used for distinguishing strains of the same species, a task which may be impossible by any other means. Such a technique, providing for the rapid and precise identification of individual strains, could prove of great significance in studies on the ecology and field pathology of the bacterial plant pathogens.

BEET CURLY TOP VIRUS

In the REVIEW OF APPLIED MYCOLOGY, 37, p. 326, reference is made to beet curly top virus in Bulgaria: it is a literal translation of the Bulgarian words Kidrav rúkh, meaning curly top. As the American beet curly top virus has not been reported previously from Europe enquiries were made and it now transpires that the identity of the Bulgarian virus has not yet been established. The original name, however, is to be retained by Bulgarian authors for a disease which causes the upper leaves of the plant to curl, pending exact identification of the causal virus.

In order to avoid confusion it is intended in future to refer to this virus in R. A. M. as Bulgarian "beet curly top" virus, until its identity is finally known.

In R. A. M., 36, p. 157, in an abstract of a book by Drachovská-Simanová, there is another reference to beet curly top. This, however, is a mistranslation, which should read "beet leaf curl". An erratum will be published in the annual index of vol. 37.

NAMES CHANGES IN HERB. I. M. I., 1958.

Clasterosporium flagellatum (Syd.) M. B. Ellis syn. Cheiropodium flagellatum Syd.; Cochliobolus nodulosus Luttrell syn. Helminthosporium nodulosum Berk. & Curt. ex Sacc.; Cryptogene Syd. syn. Cryptogenella Syd.; Glomerella cingulata (Stonem.) Spauld. & Schrenk. syn. Colletotrichum coffeanum Noack.; Nectria haematococca Berk. & Br. syn. Nectria trachyleana Syd.; Ophiocordyceps davulata (Schw.) Petch syns. Cordyceps clavulata (Schw.) Ell. & Ev. and Isaria lecaniicola Jaap.; Otthia spiraeae (Fuckel) Fuckel syns. Diplodia sarmentorum (Fr.) Fr. and Otthia pyri Fuckel; Phacidiella coniferarum Hohn. syns. Phacidiopycnis pseudotsuga (Wils.) Hohn. and Phomopsis pseudotsugae Wils.; Pleospora betae Björling syn. Phoma betae Frank; Puccinia conclusa Thüm syn. Puccinia ranagnoliana Maire & Sacc.; Sporidesmium altum (Preuss) M. B. Ellis syn. Helminthosporium altum Preuss; S. aturbinatum (Hughes) M. B. Ellis syn. Podoconis aturbinata Hughes; S. bicolor (Hughes) M. B. Ellis syn. Podoconis bicolor Hughes; S. bonarii M. B. Ellis syns. Clasterosporium obclavatum Bonar non C. obclavatum (Cooke) Sacc. and S. obclavatum Cooke; S. cookei (Hughes) M. B. Ellis syn. Podoconis cookei Hughes; S. flagellatum (Hughes) M. B. Ellis syn. Podoconis flagellata Hughes; S. fragilissimum (Berk. & Curt.) M. B. Ellis syn. Helminthosporium fragilissimum Berk. & Curt. apud Berk.; S. harknessii (Sacc.) M. B. Ellis syn. Clasterosporium harknessii Sacc.;

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FROM NEAR AND FAR

It is reported in the F.A.O. PLANT PROTECTION BULLETIN of December 1958 that dwarf disease of maize, characterized by dwarfing of plants and swellings of the veins on the undersurfaces of the leaves, has appeared in many parts of Israel. This appears to be the same disease as that reported by Elizabeth Harris from Nigeria in C.P. NEWS of October 1958.

In the same number of the BULLETIN R.L. Nagpal records a survey of citrus in Bombay State, India, which has confirmed the presence of the tristeza virus, and the suspected occurrence of xyloporosis, psorosis A, and psorosis B.

A symposium on "Fungus Diseases in India" was held under the auspices of the School of Tropical Medicine, Calcutta, in December 1958. One section was devoted to Medical Mycology, which is an indication of the wider interest now being taken in this much neglected subject.

The advance of science in Britain is exemplified by the scheme to establish a new National Lending Library for Science and Technology under the administration of the Department of Scientific and Industrial Research, which it is expected will come fully into operation in 1961. It will absorb the present lending service of the Science Museum Library, which will be taken over by the greatly enlarged Imperial College of Science and Technology. A nucleus for the major project already exists in the D.S.I.R. Lending Library Unit in Regents Park, London, which has since 1957 been of much assistance to C.M.I. in providing an expanded service of Russian literature for abstracting. A Russian translation service is also being organized in connection with the scheme.

A new five-year plan for the D.S.I.R. has been announced in the House of Commons. It is proposed to spend in the coming quinquennium about £61 million pounds on research compared with £36 million for 1954-58, and by 1963 it is expected that nearly 4,000 students will be receiving grants, in addition to nearly £2 million expenditure for special research in the universities.

Publications of Interest

COCOA CONFERENCE 1957 (Cocoa, Chocolate & Confectionery Alliance, 11, Green Street, London, W.1. pp. xiv + 326 + 35 plates, 1958. 63s.) contains full accounts of research into and methods of control adopted for the major cocoa diseases of West Africa, notably swollen shoot virus, black pod (Phytophthora palmivora), and capsid die-back (Calonectria rigidiuscula).

The Alliance has now published an index to the reports of the nine Cocoa Conferences held between 1945 and 1955 at the very reasonable price of 5s. per copy. It is obtainable from the Alliance at the above address.

THE REGISTER OF CURRENT SCIENTIFIC RESEARCH AT SOUTH AFRICAN UNIVERSITIES, 1957 (Pretoria: S.A. Council for Scientific and Industrial Research, 1958): grouped under subjects with author and subject indices.

A new abstract journal in English has recently appeared from Japan, namely ABSTRACTS OF RESEARCHES. No. 1, published in April 1958 by the Japan Monopoly Corporation, 2 Aoi-cho, Akasaka, Minato-ku, Tokyo, has just been received at C.M.I. It contains 16 abstracts of papers on tobacco diseases.

Recent developments in the use of aircraft in agriculture and forestry are highlighted by the appearance of a new quarterly periodical AGRICULTURAL AVIATION (European Agricultural Aviation Centre, the Hague, Holland: subscr. 24s. in Europe), which sets out to cover activities in all parts of the world. The

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MICROTEXTS

by G. C. Ainsworth

It is common knowledge that the output of scientific publications is vast and that that of plant pathological literature is very considerable: how vast and how considerable are not accurately known. The current edition of the World List of Scientific Periodicals has 24,029 entries for periodicals published during 1900-1950. The output of chemical literature was recently estimated at 500 printed pages a day; that of the plant sciences is perhaps half this figure. In the Bibliographie der Pflanzenschutzliteratur for 1951 (the latest year available), more than 12,500 references to the work of more than 7,500 authors on plant protection in the wide sense were compiled by scanning some 3,000 different periodicals. On a conservative estimate at least half these publications must fall within the narrower field of plant pathology as generally understood: the 1958 rate was probably higher.

Unavailability of Literature

Lindau and Sydow in their Thesaurus compiled 41,860 references to publications on all aspects of mycology up to 1910 and quite a high proportion of these have a more or less direct bearing on plant pathology. (Plant pathologists were not formerly designated 'mycologists' without reason.) It seems probable, therefore, that during the past seventy years there have been a quarter of a million publications potentially relevant to any plant pathologist seeking facts, and for those interested in the systematics of pathogenic fungi the literature extends back for another seventy years. Two major but related problems, which time can only aggravate, connected with this accumulation of data are concerned with methods for its storage and methods by which the information can be rendered accessible.

The results of scientific research and integrations of knowledge are conventionally stored as journals and books. The increasing worldwide interest in plant pathology and mycology has made it abundantly clear that there are insufficient copies of many valuable older works to meet the present and future demands. This has led to a few major works and journals (and more will certainly follow) being reprinted by photo-offset - a very satisfactory but rather expensive process. The expenditure of £40 on the reprint of Lindau and Sydow's Thesaurus by any centre having mycological interests or of £30 by a teaching department on the six volumes of Buller's Researches would be amply justified. Similarly reprints of Fries's Systema or Persoon's Synopsis at approximately £20 apiece are a 'must' for any institute with a major interest in mycological taxonomy which does not already possess these works. On the other hand small and less wealthy institutions, and individuals would quickly find themselves unable to buy comprehensive collections of such reprints in many fields. Further, books are bulky and the cost of their storage high.

Alternatives

During recent years, and particularly during the past decade increasing use has been made of photographic methods for reproducing books and other printed matter very compactly on standard sized cinematograph film at 1 or 2 pages per frame (microfilm) or as microprint at 20-60 pages on one side of a 5 × 3 in. card (microcard) or flat film (microfiche). There is not space to discuss the pros and cons of these alternatives. Special readers for microfilm and microfiches are more cheaply made commercially or more easily improvised than are those for microcards (which all involve the episcope principle) but microcards are very conveniently consulted by the use of the low power binocular microscopes found in every biological laboratory. A microfilm negative is the cheapest method for single copies, but all the methods are relatively inexpensive and with a reasonable demand could be very cheap.

One of the latest developments is that of 'xerography' (dry printing) by means of which an ingenious machine (devised by University Microfilms, Ann Arbor, Michigan)

can produce by an electrostatic process permanent, full-size, enlargements from microfilms on a continuous roll of paper at the rate of 20 feet a minute. The resulting paper strip (printed on one side) is then folded on itself to give a replica of the original book. Provided a microfilm is available, a 200-page book can be produced by this method and bound for £3, which means that one copy of any much needed book can be obtained at a not unreasonable cost. A collection of originals of reproductions of all the major contributions in any particular field should eventually be within easy reach of every specialist or student.

Practical Application

Some idea of the extent to which micro-recording is being adopted is given by the example of the University of Manchester library which already has 120,000 volumes in microtext, and by 1954 the Shakespeare Institute of the University of Birmingham had microfilms of 10,000 of the 30,000 books published in England before 1641. Further, microcard (or microfiche) editions of a number of current periodicals are available to subscribers to the journals, who, instead of being put to the high binding and storage costs of the printed volume, can dispose of the originals and file away a few cards.

By and large scientists do not seem to have taken much interest in these new facilities. Few scientists are historically minded. The results of much of the best experimental work is quickly superceded and so very rarely consulted. Many results, however, remain, which if more generally available would save both manpower and expense, and a number of organizations and commercial firms are making unco-ordinated attempts to meet the growing demand for microtexts. Most laboratories and special libraries include a certain number of microfilms and microcards among their stocks. At the C.M.I. such material of articles in journals or books borrowed from outside libraries, whether for abstracting, for noting new species, or needed for reference by members of the staff is accumulating quite rapidly.

In these notes on the storage problem nothing has been said as to methods of access, although the more widespread distribution of literature as microtexts does imply that the data they contain become more generally accessible. At the C.M.I. conventional indexes are still just adequate, but now looming ahead is the possible deployment of electronic machines which can locate required data stored on magnetic tape with great accuracy and at incredible speed.

[Micro Methods Ltd. (East Ardsley, Wakefield, Yorks.), assisted by the C.M.I., are issuing a series of microcard and microfiche editions of mycological classics including Salmon, Erysiphaceae, 1900-1902 (30s.); Berkeley and Broome, Notices of British Fungi, with Ramsbottom's Index (35s.); Fries, Hymenomycetes Europaei, 1874 (63s.) and Micheli, Nova genera plantarum, 1729 (42s.) whilst Rabenhorst's Kryptogamenflora (Bd. 1, Abt. 1-5) is in preparation: the C.M.I. can supply microfilms of Fries, Systema mycologicum (91s.) and Persoon, Synopsis fungorum (32s.), of which microcard editions are available from the Microcard Foundation, Madison 5, Wisconsin, U.S.A.]

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S. inflatum (Berk. & Rav.) M. B. Ellis syn. Helminthosporium inflatum Berk. & Rav. apud Berk.; S. macrurum (Sacc.) M. B. Ellis syns. Helminthosporium macrurum Sacc. and Podoconis macrura (Sacc.) Hughes; S. parvum (Hughes) M. B. Ellis syn. Podoconis parva Hughes; S. pedunculatum (Peck) M. B. Ellis syn. Clasterosporium pedunculatum Peck; S. wroblewski (Bubák) M. B. Ellis syn. Clasterosporium wroblewski Bubák; Thaxteria fusca (Fuckel) Booth syn. Chaetosphaeria fusca Fuckel; Thaxteria phaeostroma (Dur. & Mont.) Booth syn. Chaetosphaeria phaeostroma Dur. & Mont.

SECRETARIES OF ASSOCIATIONS OF INTEREST TO PLANT PATHOLOGISTS, 1959

Association of Applied Biologists: General Secretary, Dr. L. Broadbent, Glasshouse Crops Research Institute, Rustington, Littlehampton, Sussex.

Botanical Society of the British Isles: General Secretary, Dr. J.G. Dony, 41 Somerset Avenue, Luton, Bedfordshire.

Botanical Society of Edinburgh: Secretary, P.S. Green, Esq., Royal Botanic Garden, Edinburgh 4.

British Mycological Society: Secretary, Dr. J.G. Manners, Department of Botany, The University, Southampton.

Linnean Society: Secretary, Botanical, Dr. C.R. Metcalf, The Linnean Society, Burlington House, London, W.1.

Royal Entomological Society of London: Secretary, P. Freeman, Esq., Royal Entomological Society, 41 Queen's Gate, London, S.W.7.

Royal Horticultural Society: Secretary, A. Simmonds, Esq., Royal Horticultural Society, Vincent Square, London, S.W.1.

Society for General Microbiology: General Secretary, Prof. K.E. Cooper, Bacteriology Department, The University, Bristol.

Systematics Association: Secretaries, Dr. A.J. Cain, University Museum, Oxford. R.D. Meikle, Esq., Royal Botanic Gardens, Kew, Surrey.

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first number contains inter alia articles on aerial spraying of potatoes against blight, and the control of needle cast of pines.

COLONIAL RESEARCH 1957-58, the report of the Colonial Research Council, reveals that over £1,300,000 was spent in promoting research in the Colonial dependencies during the period under review; some 35 per cent. of Colonial Development and Welfare funds was expended on agriculture and forestry. (Cmnd. 591. H.M. Stationery Office, 1958: price 14s. 6d.)

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PERSONAL NEWS

C.M.I. News

A party of biologists from Emanuel School who visited the C.M.I.

It was announced in the New Year Honours List that Miss Kathleen Secker, of the C.M.I. staff, well known to many of our readers, has been awarded the M.B.E. Miss Secker was the first abstractor to be appointed by Sir Edwin Butler to the Imperial Bureau of Mycology, as it then was, and has contributed a vast number of abstracts from many languages to both R.A.M. and the REVIEW OF MEDICAL & VETERINARY MYCOLOGY since their initiation.

A.C. Hayward, Ph.D. has been appointed to the newly constituted post of bacteriologist. He is a graduate of Birmingham University, where he obtained his Ph.D. for work on the taxonomy of the lactobacilli, and has come to C.M.I. from the Colonial Microbiological Research Institute, Trinidad, where, among other projects, he studied bacterial plant pathogens.

Visitors

Among overseas visitors to the C.M.I. have been:- A.G. Bailey, Dr. Elizabeth Harris, E.C. Hislop, and J.O. Uyo, Nigeria; Hikmet Ismen, Turkey; Dr. J. Nutman, Kenya; Dr. D.L. Olivier, South Africa; Dr. K.V. Srinivasan, India; Miss A.C. Stolk, Holland; Dr. J.H. Warcup, Australia.

Bailey, Harris, Olivier and Stolk spent some weeks working in the Herbarium. A party of senior biological scholars from Emanuel School paid a visit, and a party from the Glasshouse Crops Research Institute, Rustington, lead by Dr. L. Broadbent, spent a day at the Institute in February.

Appointments, Promotions, Retirements, etc.

The Overseas Service Division of the Colonial Office announce the following: M.D. Ffrench-Mullen, director of agriculture, Northern Rhodesia; I.S. Hutcheson, assistant director of agriculture, Mauritius; M. Lunan, deputy director of agriculture, Tanganyika; E.H. Nichols, assistant director of agriculture, Hong Kong.

Mr. S. Kirsnamurti, Counsellor (Commercial) in the India High Commission, has been appointed member of C.A.B. Executive Council for India in place of Mr. T. Swaminathan.

Mr. Martin O'Doherty has replaced Mr. C.D. Ryan as C.A.B. liaison officer. His address is Department of Agriculture (Economics Division), Dublin, Republic of Ireland.

G.K. Argles has been appointed director of the Commonwealth Bureau of Horticulture and Plantation Crops, East Malling.

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OVERSEAS NEWS

CANADA

TREE FRUIT VIRUS DISEASES IN BRITISH COLUMBIA

This is a brief account of recent investigations of tree fruit virus diseases in the British Columbia Interior. It was prepared by Dr. M. F. Welsh, Plant Pathology Laboratory, Summerland, and his colleagues, Dr. J. M. Wilks, T. B. Lott and F. W. L. Keane. Current studies of the virus diseases of cherry and apricot stress the identification of strains and host ranges, and the elucidation of obscure interrelationships among the diseases. The investigations of virus diseases in pome fruits have been initiated more recently. The early results suggest an unexpectedly common incidence of viruses in British Columbia apple and pear plantings.

Stone fruit viruses in the Kootenays

Recent work by E. L. Reeves in the State of Washington and by investigators elsewhere has demonstrated the common occurrence in a number of flowering cherry varieties of a virus that causes small-fruit symptoms in sweet cherry similar to those of the little cherry disease. The virus was found first in Prunus serrulata vars. Kwanzan and Shirofugen, and was called the K and S virus. Natural occurrence of the little cherry disease has been recorded thus far only in the Kootenay region of British Columbia. At Creston, B. C., within the area of occurrence of the little cherry disease, the two diseases have been compared in the same range of test plants. These studies have disclosed no difference in symptoms on sweet cherry fruits or foliage, in the reactions of peach and choke-cherry (Prunus virginiana var. demissa), and in the rate of spread through sweet cherry trees. A group of flowering cherry trees that have been growing in the Kootenays since 1933, when little cherry disease was first found in a neighbouring sweet cherry orchard, have now been found affected by a virus that causes little cherry symptoms. Little cherry virus has been found also in bushes of the wild cherry Prunus emarginata var. mollis growing in the same area. Thus, two possible explanations have been found for the outbreak of this serious disease.

Stone fruit viruses in the Okanagan Valley

Ring pox of apricot and twisted leaf of sweet cherry have been recognized for a number of years as economic diseases on these hosts. Recent work has indicated that apricot trees showing ring pox symptoms almost invariably carry the virus of twisted leaf; and that cherry trees displaying twisted leaf almost invariably carry the ring pox virus. Indexing of apricot trees free from ring pox has almost invariably failed to yield twisted leaf. The host range of twisted leaf has been shown to include peach, chokecherry, Prunus mahaleb, and Montmorency sour cherry, all of which carry the virus without obvious effect. Chokecherry bushes growing near affected orchards have been shown to carry virus able to cause ring pox in apricot and twisted leaf in cherry. Obviously, the prospects for successfully eradicating these diseases have become much more remote.

Trees of the flowering cherry variety Kwanzan at Summerland have been shown to carry, without symptoms, not only the K and S virus, but the viruses that cause Lambert mottle and mottle leaf. All experimental material of this variety has been destroyed. A clone of Shirofugen flowering cherry at Summerland, in 3 successive years' indexing, has appeared to be free from all 3 of these viruses. It is believed to be the only clone of the variety thus far demonstrated free from the K and S virus.

Viruses of pome fruits

Investigations are in progress to determine the importance of virus diseases in British Columbia apple and pear plantings. The need for such a programme was suggested by the accumulating evidence that virus diseases occur commonly in European countries and in New Zealand, coupled with the knowledge that at least some diseased material has been included in nursery stock imported to the North American continent.

Before 1956, the only virus disease known to be present in apple in interior British Columbia was apple mosaic. In 1957, leaf pucker of McIntosh and Spartan apple was shown to be a virus disease. In 1955 and 1956 several other diseases with virus-like symptoms were observed, and were subjected to transmission tests. No information was available on the extent to which other viruses were being carried in the trees of commercial orchards, or in trees used as sources of nursery propagating materials. Accordingly, in 1956, materials were assembled for tests designed to assess the prevalence of viruses in British Columbia apple plantings; to determine the effects of the viruses on commercial varieties, body stocks and rootstocks; and to explore the relationships and host ranges of the viruses. The first results were obtained in 1958. So far, only positive results can be considered valid. Negative results must be substantiated by readings in later years.

Early Results

These early results indicate that several viruses occur commonly in British Columbia apple plantings.

The virus that causes stem pitting in Virginia Crab and other crab apple and apple varieties has been transmitted to healthy Virginia Crab from apparently unaffected clones of the commercial varieties Golden Delicious, Spartan, Red Delicious, and Red Winesap, growing on affected Virginia Crab body stocks; and from apparently unaffected clones of Red Delicious, Rome Beauty, and Lord Lambourne growing directly on seedling rootstocks.

The virus of rubbery wood has been transmitted to healthy Lord Lambourne from two apparently unaffected clones of Red Delicious, and transmission is strongly suspected from clones of several other commercial varieties. Two of the tested clones have yielded both rubbery wood and stem pitting. However, one clone of Virginia Crab, free from stem pitting, has yielded rubbery wood, giving limited evidence that the two diseases are caused by distinct viruses.

Transmission from an apparently healthy clone of Rome Beauty to Virginia Crab has revealed the presence of an unreported virus that causes dwarfing and severe decline of Virginia Crab.

Graft inoculations from Virginia Crab clones with and without stem pitting have caused foliage symptoms in Prunus tomentosa.

In pear, the only virus disease recognized in British Columbia has been that of stony pit which affects especially Bosc variety. Fruit pitting symptoms occur in other varieties and these diseases are being subjected to transmission tests. In 1958, a fruit pitting of Flemish Beauty, which occurs with varying severity from year to year in certain trees in commercial orchards, has been transmitted. The virus passed from diseased Flemish Beauty scions applied to single limbs of Bosc pear trees to healthy Flemish Beauty scions applied to other limbs of the same trees. Lack of symptoms in the fruits of the Bosc trees thus inoculated suggests that the virus is not that of Bosc stony pit.

Vein yellows symptoms have been evident in a number of test trees used in transmission studies.

The results accumulating from these exploratory studies fo apple and pear viruses in British Columbia indicate a need for widespread indexing of trees intended for sources of rootstock and scion wood. The effects of the viruses on tree growth and productivity must be ascertained. For apple, there is urgent need for improved indexing methods.

The results here briefly summarized will be published shortly in separate papers

NEW SOUTH WALES

Lettuce Big Vein

Big vein of lettuce was first reported in New South Wales in 1939 and small outbreaks have been seen from time to time since. As in other parts of the world, its etiology has been uncertain. Following the published work of Grogan et al (PHYTOPATHOLOGY, 48 : 6, 1958) and Fry (N. Z. JOUR. AGRIC. RES., 1 : 3, 1958) on the association of Olpidium brassicae in the roots of lettuce with big vein symptoms, J. Walker, plant pathologist, has had a further look at the disease here. In three cases of big vein seen recently large numbers of resting sporagnia of Olpidium brassicae have been found in the roots. None, or only a few, has been seen in the roots of healthy plants.

Tobacco Downy Mildew

Extension of tobacco growing in New South Wales has been long restricted by losses caused by this disease, particularly by the "field mould" phase. For more than twenty years a programme of breeding for resistance has been in progress in this State and there is promise now of a pay-off. There is great interest at present in the field resistance of some of the hybrids produced from Nicotiana debneyi by H. Lea, plant breeder. Recently H. J. Willetts, plant pathologist, has joined Lea at the New England Experiment Farm, Glen Innes, for further study of these resistant hybrids and the pathogen.

Control of Shot Hole in Stone Fruits

K. E. Hutton reports that in late autumn 1958 isolated groups of trees at Young comprising almond, apricot, and peach were sprayed with 0.1 per cent. phenyl mercuric chloride. These trees, which had been heavily infected with shot hole (Clasterosporium carpophilum) for many years, have received no fungicide since. All of the PMC-sprayed trees are now almost free of shot hole lesions, whereas the incidence of this disease throughout the district is high. Nearby non-sprayed homestead apricot trees are so severely infected that the fruit is valueless and the trees almost defoliated.

A similar experiment was carried out on an isolated group of fifteen very large old neglected apricot trees at Wiseman's Ferry. These trees have a history of very severe shot hole infection. They were sprayed in early winter with 0.1 per cent. PMC, and no other spray has been applied since. The crop this season was harvested with only a very slight shot hole infection. This contrasted markedly with the extremely severe infection usually experienced in these trees and with the heavy shot hole infection which was general in apricots and other stone fruits throughout the district this season.

Hutton considers that with trees as severely infected as those used in these experiments at Young and at Wiseman's Ferry it would take two or three seasons to obtain the same degree of control by the recommended autumn and spring Bordeaux mixture 10-10-100-½ programme as that achieved by the single mercury spray applied.

Nematodes and Banana Root Rot

Evidence is growing that the burrowing nematode Radopholus similis is primarily responsible for the heavy losses of banana roots which occur in some plantations in New South Wales. The banana strain of this nematode feeds on the soft outer tissues of roots in which it forms extensive burrows and cavities. It is thought that subsequent invasions of the injuries by fungi and bacteria results in the death of roots. Preliminary pot experiments by C. Blake strongly support this view and field trials have now been laid down. Blake has shown that the nematode is capable of burrowing deep into the corm, following the bases of cord roots, and in replanting trials in plots which have been treated with nematacides hot water-treated corms have been used.

C. J. Magee

MAURITIUS

GUMMING DISEASE IN REUNION

The sugar industry of Mauritius may soon be facing a new pathological problem due to the possible existence of a different strain of the sugarcane gumming disease organism (Xanthomonas vasculorum Dowson) in the neighbouring island of Reunion.

Sugarcane stool of the variety M. 147/44, infected with gummosis, showing acute chlorosis. Reunion Island.

A severe outbreak of gummosis occurred in the sister island last year and M. 147/44, one of the leading varieties in Mauritius, was reported to be susceptible, as well as B. 34104 and R. 397. It appeared also that the progeny derived from Co. 281 was susceptible to the disease.

In Mauritius all the above mentioned varieties have been treated in gumming resistance trials and classified as resistant. When the perturbing news concerning M. 147/44 came from Reunion several fields of the variety were surveyed in Mauritius and not a single stool was found suffering from gummosis. Furthermore, at one experiment station of the Mauritius Sugar Industry Research Institute stools of M. 147/44 growing in the immediate vicinity of heavily infected D. 109 plants did not show any disease symptom. As for the progeny derived from Co. 281, thirteen varieties have been tested during the last sixteen years and all have been recorded as resistant.

In addition to the different varietal reaction to the disease in the two islands, infected canes in Reunion exhibit severe leaf chlorosis, a symptom seldom observed in Mauritius, but very similar to the one reported in 1957 on N. Co:310 in Natal. It may be that environmental conditions in Reunion, struck by two cyclones followed by a severe drought last year, may have been conducive to the development of the disease in its acute phase. However, the evidence pointing to the possible existence of a different strain of the disease organism cannot be ignored.

Gummosis has been a disease of major importance in Mauritius in the past, and has been responsible for the disappearance of the cultivated 'noble' canes.

The eradication of gumming disease cannot be contemplated on account of the presence of several alternate hosts of the pathogen in the island. The only line of defence is, therefore, the cultivation of resistant varieties. Seedlings coming out of first selection trials as well as imported varieties released from quarantine are included each year in a gumming resistance trial. All varieties found to be susceptible are discarded. Thus all canes released for commercial planting are resistant to the strain of X. vasculorum present in Mauritius. Should there be a mutation of that strain or the accidental introduction into Mauritius of a different strain, the vigilant work carried out over many years could be wasted.

It was therefore important to find out whether a strain different from the Mauritian one existed in Reunion. The pathologist of the Institute accompanied by his laboratory assistant went to Reunion to investigate the problem on the spot. The bacterium has been isolated from cane and Thysanolaena maxima - a first record for Reunion island - and after successful pathogenicity tests, cultures were forwarded to Dr. Dowson at Cambridge for comparison with the strains occurring in Mauritius and South Africa. Cuttings of varieties D. 109 and M. 147/44 were also sent to Cambridge for inoculation purposes.

The assistance which is being given by Dr. Dowson in sorting out this important question is gratefully acknowledged.

Robert Antoine

NORWAY

NORWEGIAN FOREST RESEARCH INSTITUTE

In November 1958 the recently established Section of Forest Pathology and Entomology of the Norwegian Forest Research Institute moved into a new building.

The new building, which was inaugurated on 2nd February, 1959, is called in Norwegian "Fellesbygget". You may translate it into "Joint Building". Different institutions and sections of institutions which are supposed to collaborate and to be useful to each other are brought together here.

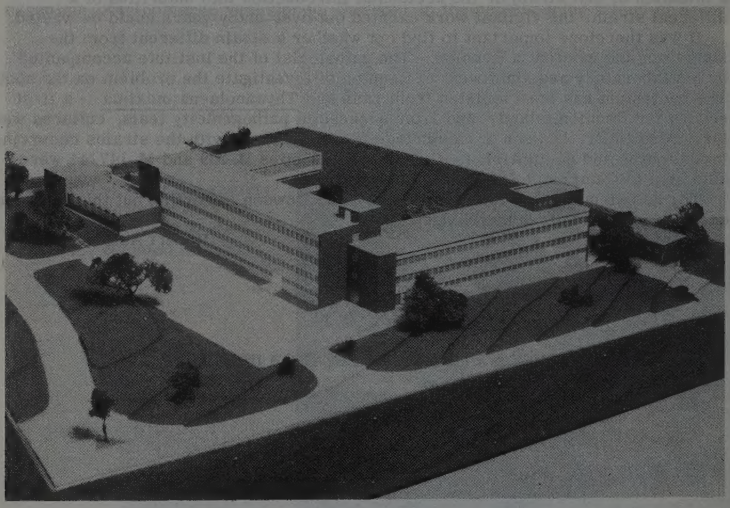
These institutions are: the Norwegian Plant Protection Institute, the Norwegian Seed Testing Station, Institute of Microbiology of the Agricultural College of Norway, Section of Forest Pathology and Entomology of the Norwegian Forest Research Institute, the Norwegian State Game Research, and the Inspector of Salmon and Inland Fisheries, Scientific Branch.

The Section of Forest Pathology and Entomology has a floorage of 250 m^2. The rooms of the Subsection of Forest Pathology are: 2 mycological laboratories, 1 office for the forest pathologist, 1 office for the assistant forest pathologist, 1 room for forest pathological collections. Together with the Subsection of Forest

Entomology we have 1 room for the lady clerk, and 1 room for advanced students.

Besides this we have collective rooms together with the botanical division of the Plant Protection Institute and the Institute of Microbiology. These are rooms for washing and sterilizing glassware and making culture media, room for weighing, and rooms kept at constant temperatures of +3°C. and +22°C., and one room for incubators kept at temperatures higher than +30°C.

The Plant Protection Institute, the Institute of Microbiology, and the Section



A model of the new joint laboratories "Fellesbygget", of the Norwegian Forest Research Institute inaugurated in February, 1959. Forest pathology is housed in the second floor of the wing on the right.

of Forest Pathology and Entomology also teach the students at the Agricultural College of Norway. The building therefore has an auditorium with seats for 72 persons, and a room for microscopy and practical microbiology for the students. We also have a room for collections of forest pathological and entomological specimens for teaching purposes.

In the building there is a main library and a main room for conferences.

Finn Roll-Hansen

LATE NEWS

(continued from p. 24)

S. J. Worsley who is known personally or by name to many readers of C. P. NEWS as secretary of the Inter-University Council for Higher Education Overseas retired in February and has been succeeded by I. C. M. Maxwell, assistant secretary since September, 1952.

W. A. Ferguson has been appointed secretary of the British Museum (N. H.) in succession to T. Wooddisse, who retired on reaching the age limit on April 1.

The Indian Agricultural Research Institute, New Delhi, has been declared a post-graduate school of university status for the purpose of awarding up to 100 M. Sc. and 50 Ph. D. degrees in all branches of agricultural science. The professor of Plant Pathology is Professor C. V. Subramanian, lately reader of mycology, department of botany, Madras University.

Sir Harry Champion, professor of forestry at Oxford, has retired and is succeeded by Prof. M. V. Laurie, formerly chief research officer to the Forestry Commission. The latter will be followed by T. R. Peace, forest pathologist at Alice Holt Lodge, Farnham, Surrey.

Prof. F. G. Gregory F. R. S. has been elected professor emeritus of plant physiology in the University of London on his retirement from I. C. at the end of December last, and is succeeded in the chair of plant physiology by Dr. Helen Porter, the first woman to hold a professorial post in the College.

Prof. R. Brown, professor of botany at Edinburgh and Dr. D. Trail, research director of I. C. I., have been elected Fellows of the Royal Society of Edinburgh.

R. W. Marsh and Dr. J. T. Martin have been appointed assistant directors of the Long Ashton Horticultural Research Station.

Awards

The following awards were announced in the New Year Honours List: Knight. Sir Reginald Linstead, rector of Imperial College, London; K. B. E. Sir Geoffrey Peren, principal, Massey Agricultural College, New Zealand; C. B. E. R. B. Tennent, Director of Agriculture, New Zealand, Prof. S. J. Watson, professor of agriculture and rural economy, Edinburgh; O. B. E. F. C. Ford Robertson, director, Commonwealth Forestry Bureau, Oxford.

OBITUARY

Old Cambridge students will learn with regret of the death in August, 1958, of F. R. Petherbridge of the School of Agriculture.

T. B. M. S. FOR SALE

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● Out of print volumes of the REVIEW OF APPLIED MYCOLOGY (Vols. 1-37) are being reprinted. There are a few complete sets now available and more will be ready later in 1959. Orders will be supplied in strict rotation as complete sets become available. Price complete, postage paid, £156.

Recently issued

AN ANNOTATED LIST OF SEED-BORNE DISEASES with extensive literature references, by Mary Noble, J. de Tempe, and Paul Neergaard. 164 pp. Published in collaboration with the International Seed Testing Association.

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CLUB ROOT OF CRUCIFERS CAUSED BY PLASMODIOPHORA BRASSICAE by John Colhoun. A monograph on a classical disease invaluable to teachers and research workers (Phytopathological Paper No. 3. 108 pp. + 4 plates. Bibliography of 11 pages).

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No. 67. HAPLOBASIDION, LACELLINOPSIS, AND LASCELLINA. By M. B. Ellis. 15 pp., 9 figs., 1957. 6s.

No. 68. STUDIES OF PYRENOMYCETES: I. FOUR SPECIES OF CHAETOSPHAERIA, TWO WITH CATENULARIA CONIDIA. II. MELANOPSAMMA POMIFORMIS AND ITS STACHYBOTRYS CONIDIA. By C. Booth. 27 pp., 7 figs., 1957. 9s.

No. 69. SOME SPECIES OF TERATOSPERMA. By M. B. Ellis. 7 pp., 5 figs., 1957. 3s.

No. 70. CLASTEROSPORIUM AND SOME ALLIED DEMATIACEAE — PHRAGMOSPORAE. I. By M. B. Ellis. 89 pp., 63 figs., 1958. 30s.

In preparation for publication in the Spring ————

Clasterosporium and some allied Dematiaceae. Pt. II by M. B. Ellis, also studies on Nectria by C. Booth and Cercosporeae of Sierra Leone by F. C. Deighton.

Substantial discount is also given for standing orders of all "Mycological and Phytopathological Papers" as issued.

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